

Federal Education Agency of the Russian Federation

**State institute of higher professional education
MOSCOW STATE UNIVERSITY OF WOOD**



**CRITICAL AND WORK LOAD COMPUTATION
FOR SUPPORT PILLARS**

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1. Support pillars characteristics: length $l = 4.5$ m, $d = 0.14$ m, made of spruce, pine, and birch wood. Operative humidity 12-16%.

2. Support pillars in the presented structure of suspended awnings for gardens, car parks, etc., from the strength of materials theory point of view, can be attributed to bars with one fixed (the lower one) and one hinged (the upper one, wire-stretched) end.

Critical load P_c , at which the stability of such bars is disturbed, is calculate following the formula (N.M. Belyaev, Strength of Materials, State Publishing House of Technical and Theoretical Reference Materials, Moscow, 1954):

$$P_c = 2 \frac{\pi^2 EJ}{l^2},$$

where E – material elasticity modulus, GPa;

$$J – \text{wire's moment of inertia, m}^4; J = \frac{\pi d^4}{4}$$

Restraining force P_r on the pillar:

$$P_r = P_c / k_s,$$

where k_s – factor of safety, which accounts for the pillar's initial curvature, load action eccentricity, material's non-homogeneity, etc.; for wood it is taken as equal $k_s = 3$

Midvalues of the elasticity modulus E for wood (Governing Technical Materials. Wood. Physical and Mechanic Properties' Rates. – Moscow. Standards' Committee, 1962) are equal: spruce – 9.6 GPa, pine – 10.3 GPa, birch – 14.2 GPa.

Calculations are summarized in the table.

Table No.

Critical and Work Loads on Pillars $l = 4.5$ m, $d = 0.14$ m

| Species | E , GPa | J , m ⁴ | P_c , Pa | P_r , Pa |
|---------------|-----------|-----------------------|----------------------|---------------------|
| Spruce | 9.6 | 1.89·10 ⁻⁵ | 26.0·10 ⁴ | 5.7·10 ⁴ |
| Pine | 10.3 | | 19.0·10 ⁴ | 6.3·10 ⁴ |
| Birch | 14.2 | | 17.7·10 ⁴ | 8.7·10 ⁴ |

For reference. The critical force and, correspondingly, the restraining force for a pillar with one fixed (lower) end, and the other free (upper) end, is by 8 times smaller.

CONCLUSION.

Stability of birch pillars is higher than that of spruce pillars – by 1.5 times, pine pillars – by 1.38 times.

Approved by
Head of the Wood Drying and Protection Department
of Moscow State Forest University, Professor
A.I. RASEV